Taipei City's Zero Landfill Policy

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July 16 2008
Sacramento, California

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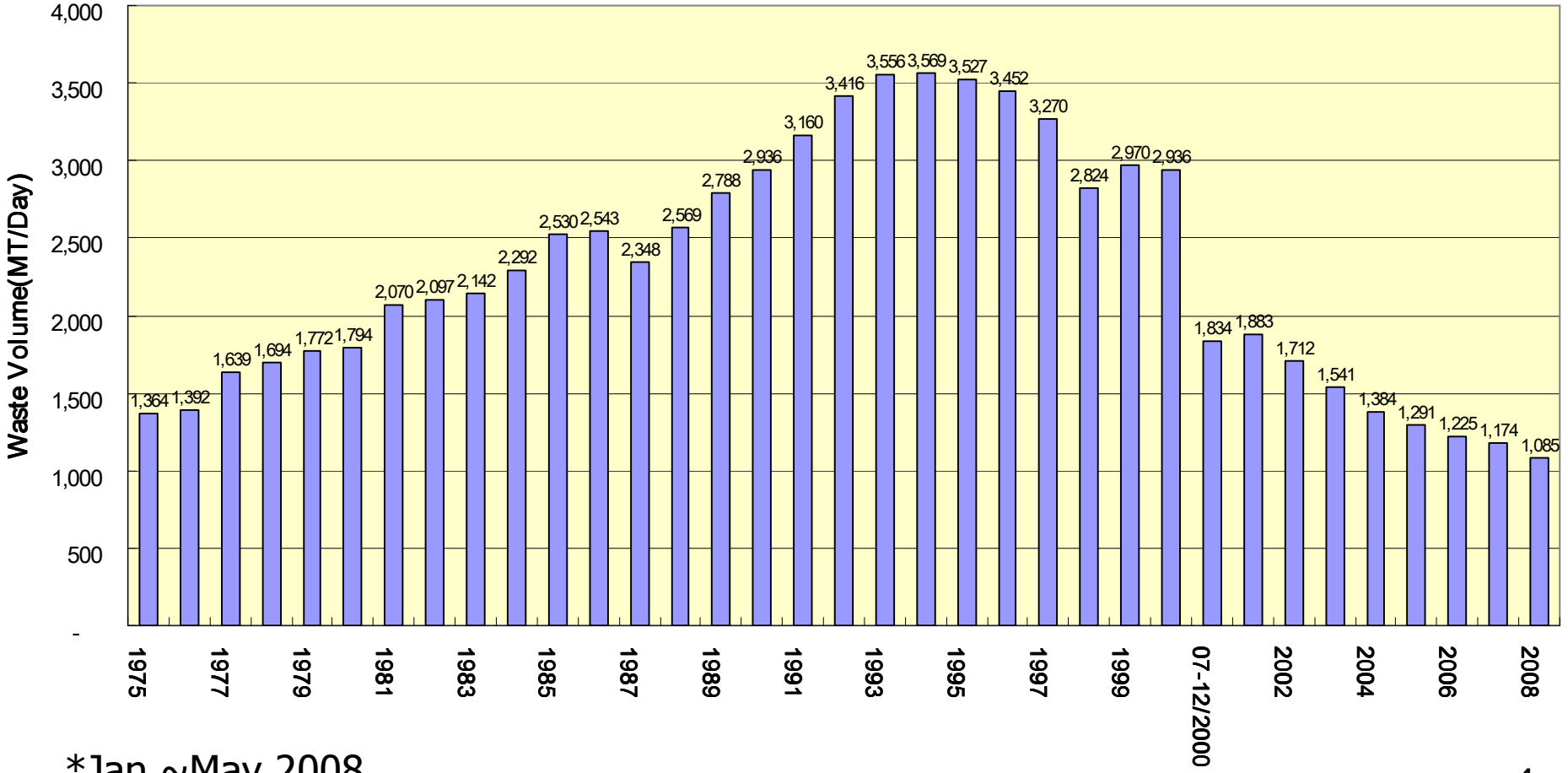
1.Overview of Taipei City

- Area: 271.80 km² (0.76% of Taiwan's total area)
- Population: 2,629,269 (12% of Taiwan's total population
- 12 administrative districts

2.Waste Disposal Framework

(1) Household Waste volume in Taipei City From 1975 to 2008.



*Jan.~May 2008

2.(2) The chemical and physical composition of household waste in Taipei City in 1997 and 2007

		Items	Percent by weight or Kcal/kg	
			1997	2007
Chemical analysis		Moisture content (%)	40.56	45.33
		Ash content (%)	13.54	9.16
		Combustible (%)	45.90	45.51
		Higher heating value (Kcal/Kg)	2,688	2,471
		Lower heating value (Kcal/Kg)	2,246	2,004
Physical analysis	Recyclable materials	Paper products (%)	26.06	38.62
		Plastics (%)	17.64	17.90
		Leather and rubber (%)	0.00	2.79
		Metals (%)	3.51	1.60
		Glass (%)	3.54	2.90
		Subtotal	50.75	63.81
	Non-recyclable materials	Textiles (%)	4.56	5.38
		Yard Wastes (%)	3.47	4.27
		Food and misc. organic wastes (%)	40.45	26.00
		Ceramics (%)	0.55	0.40
		Stone and Dirt (%)	0.22	
		Others (%)	0.00	0.14
		Subtotal	49.25	36.19

2.(3) Waste Disposal Policy

- Before 1987: Looking for sanitary landfill
- 1987~1997: Incineration was the first priority treatment method to reduce the waste volume.
- After 1997: Waste Reduction and Waste Recycling became the first priority.
- Now:

  Minimize combustible waste and Maximize recycling of waste.

2.(4) Capacity and Investment of Incinerators and Landfills in Taipei City

Incinerator	Capacity (tons/day)	Capital Investment (NTD) USD:NTD=1:30.5	Land price (NTD)
Neihu(1991)	900	2,755,567,244 USD$90,346,467	171,000,000
Mucha(1995)	1500	4,652,537,024 USD$152,542,197	82,570,800
Beitou(1998)	1800	7,089,923,128 USD$232,456,496	491,045,484
Landfill	**Capacity (m^3)**		
Futeh(No.1, 1985)	8.00million	808,875,320 USD$26,520,502	190,000,000
Shanchuku(No.2, 1994)	6.17million	1,652,171,765 USD$54,169,566	5,822,909,581
Neihu(No.3)*	0.66 million	1,056,260,000 USD$34,631,475	1,295,160,000

*(undergoing Environmental Impact Assessment)

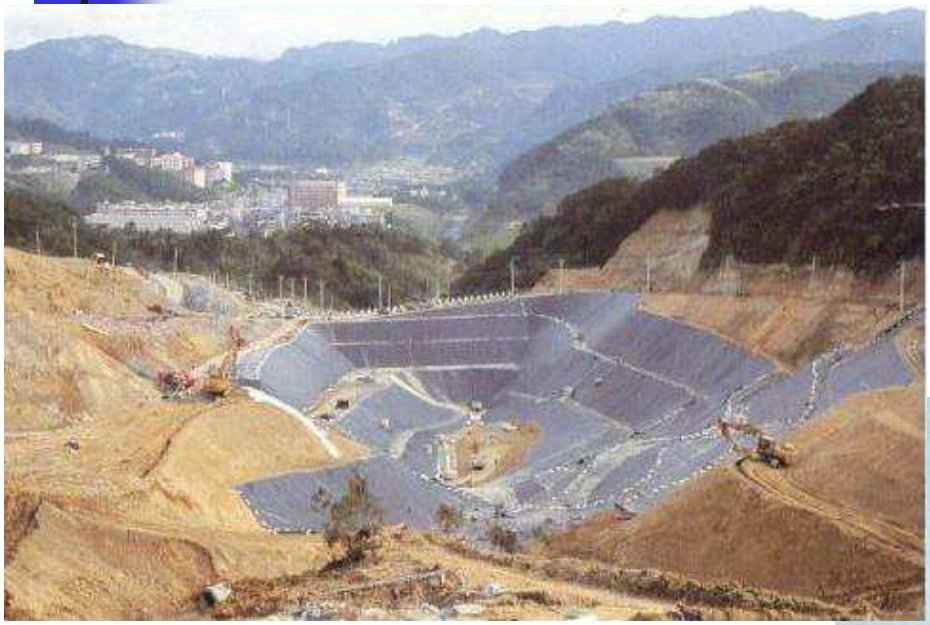
2.(5) Neihu Incineration Plant, 1991~ (3×300MT/D. LHV=1,350Kcal/kg)

2.(6) Mucha Incineration Plant, 1995~ (4×375MT/D, LHV=1,600Kcal/kg)

2.(7) Beitou Incineration Plant, 1998~ (4×450MT/D, LHV=2,400Kcal/kg)

2.(8) Present-day Neihu Dumpsite, used from 1970-1985

2.(9)Futeh,1985~1994



2.(10)Rehabilitated park at Futeh sanitary Landfill (Completed in 2004)

2.(11)Shanchuku Sanitary Landfill, 1994~

2.(12)Methane-to-energy recovery system at Shanchuku, 1999~

3.Three-in-one policy

(1) What is the three-in-one policy?

- In 1995, the total volume of waste in Taipei City had increased drastically. People left their home waste on the ground before garbage truck arrived. Waste separation and waste recycling were not actively done at that time.
- Three-in-one policy was to educate citizens to:
  1. Remove wastes from the ground
  2. Separate waste into categories, and
  3. Recycle waste

3.(2) A waste collection point before 3-in-1 project (1995)

3.(3) The waste collection point after 3-in-1 project (2002)

3.(4) Influences of three-in-one policy

1. Sanitation improved on the street.
2. People developed habit to dispose garbage at designated time and place.
3. Set the foundation for the future Per-bag Trash Collection Fee Policy.

4.Four-in-one policy

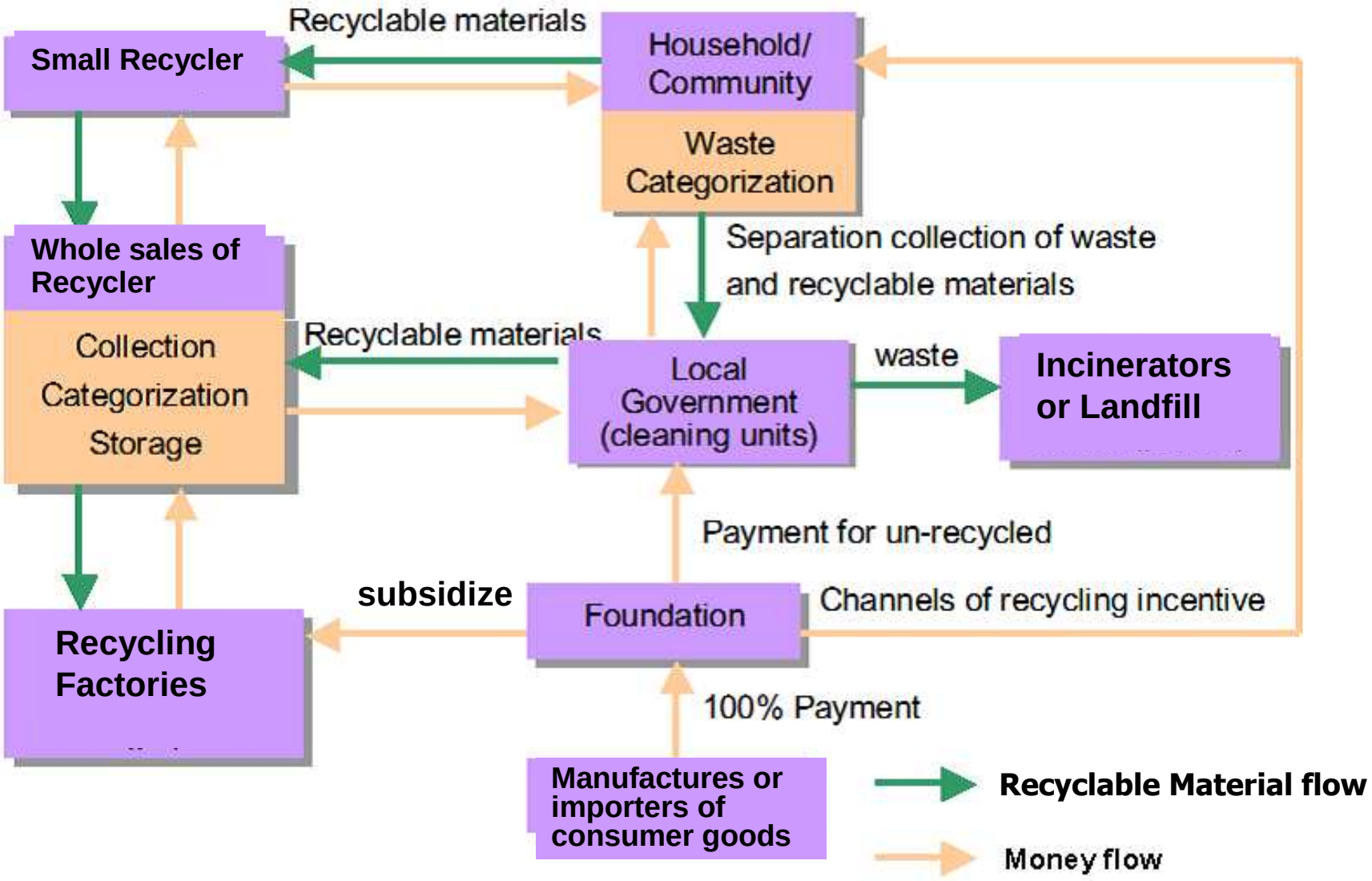
(1) What is the four-in-one policy?

- At the same time in 1995, the Taiwan EAP (in central government) faced the garbage increasing problem. An economic incentive policy was launched to tax consumer products a recycling fee before merchandises were sold.
- The EPA took the money to establish a special recycling fund, which was used to subsidize the public, local government and the waste recyclers to encourage them to carry out waste recycling.

4.(2) Who are the four players?

1. **Public:** Waste sorting in the home.
2. **Local government:** Cleaning unit to implement waste recycling.
3. **Recyclers:** Collect and transport the waste resources to waste dealers and recycling plants.
4. **Recycling Fund:** Manufacturer or Importer pays fee to establish a fund to support the recyclable materials which do not have enough economic incentive for recycling.

4.(3) The frame work of 4-in-1 project



The green line is material flow and orange one is money flow

4.(4) Some examples of recycle items which subsidize by Taiwan EPA Recycling Fund and their subsidized rates

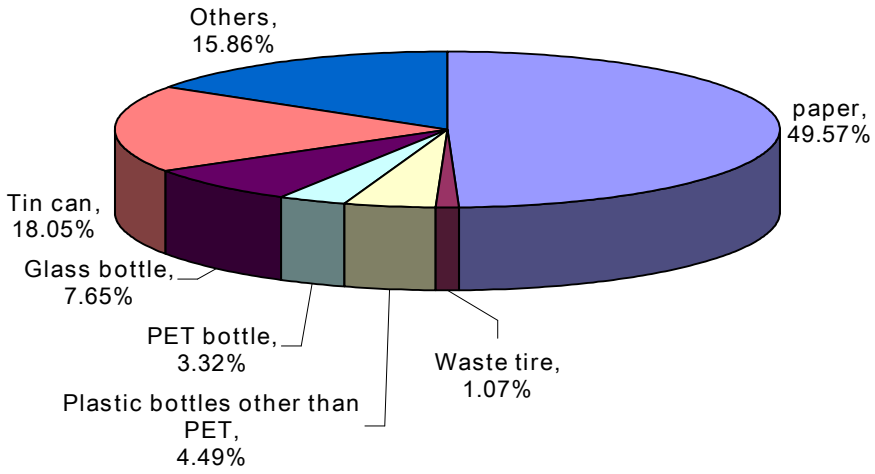
Unit：NTD/Kg

Items		Recycling fee charge by EPA	Recycling fee subsidized to recycler by EPA	Recycled price in market (summer 2008)
Glass bottle		1.55	2	---
Tin can		1.32	3.1	7~10
PET bottle		11.58	5	10~15
PE bottle		8	5	10~15
News paper		---	---	4.3~5
Dry battery with Mn & Zn		18.97	55	10~15
Dry battery with Hg		56	443.41	
TV set 25 inches		371(NTD/set)	379.5	80~100NTD/set
Notebook computer		39(NTD/set)	303	150NTD/set
Tyre (diameter)	(12"-14") 8.7 kg/piece	21(NTD/piece)	3.2NTD/kg	---
	(15"-19") 16.8 kg/piece	40(NTD/piece)	3.2NTD/kg	---
	(20"-23") 49.7 kg/piece	120(NTD/piece)	3.2NTD/kg	---

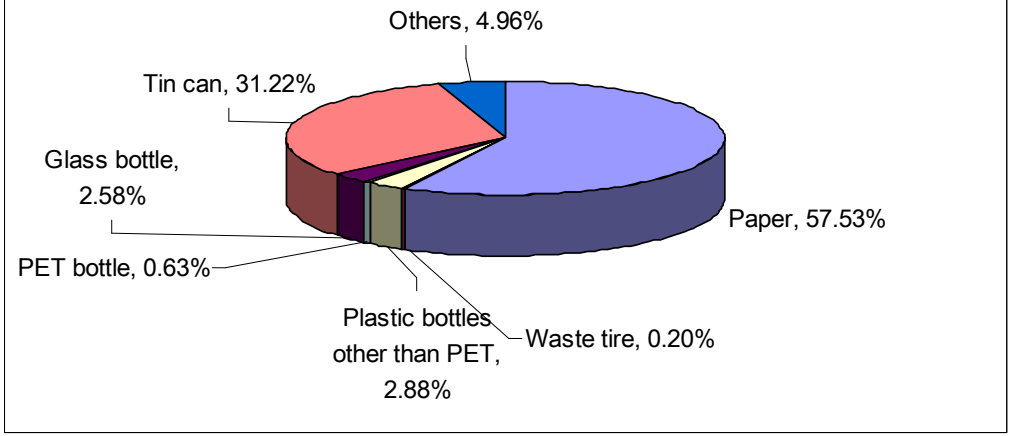
4.(5) Waste Materials recycled by cleaning unit in Taiwan and Taipei City, 2007

Taiwan Area

(Total:2,408,828 tons)

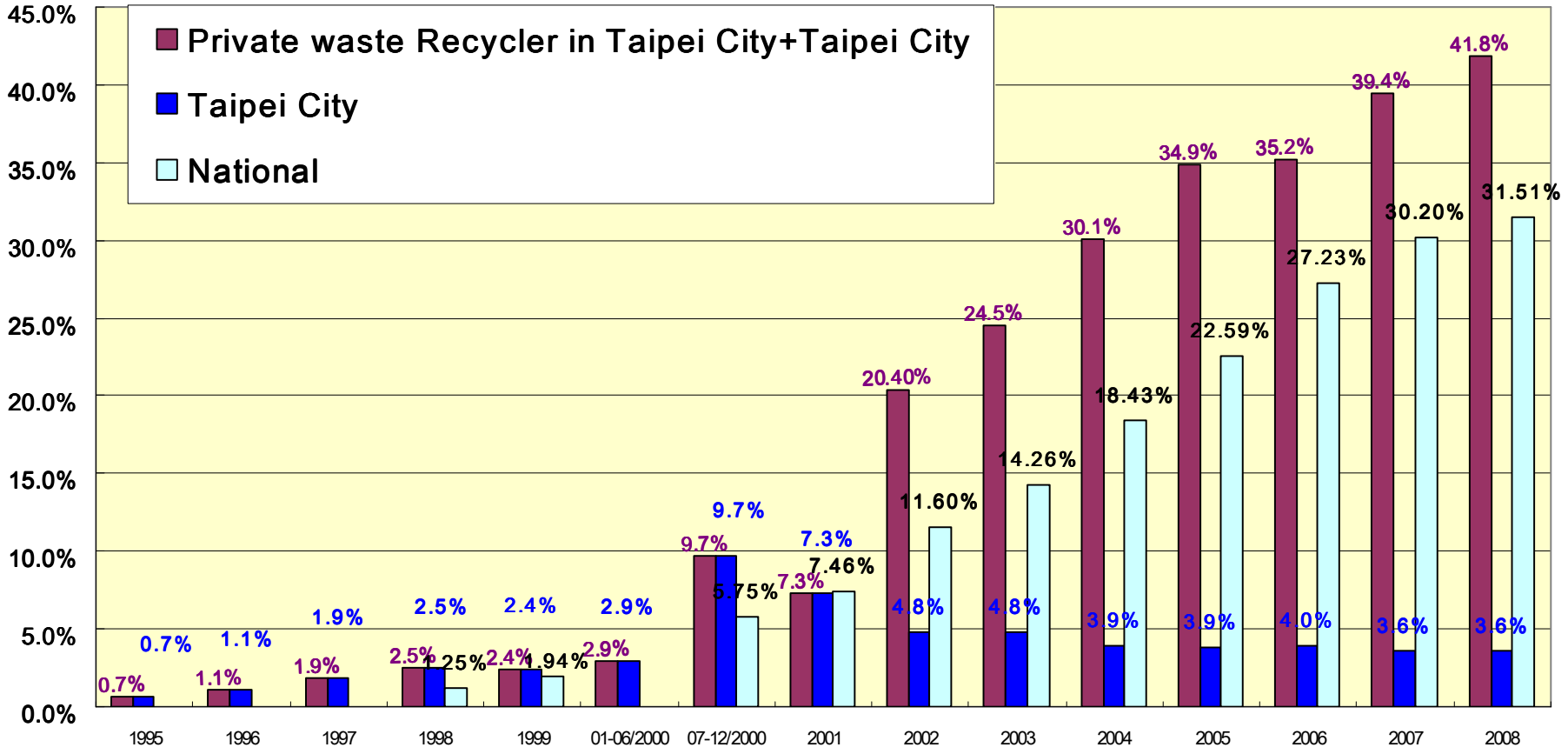


Taipei City (Total:388,087 tons)



Others: Waste batteries, metals, TeraPack, waste computers, electronic goods, etc.

4.(4)Comparison of resource recycling rate in Taipei City and Taiwan from 1995 to 2008.



*Jan.~Apr. 2008

5.Per-bag Trash Collection Fee

(1) Per-Bag Trash Collection Fee Policy (PBTCF), began in July 2000

1. Waste Disposal Act (Article 11) provides the legal basis for government collection of waste fee.
2. Before July 2000, trash fee was attached to each household monthly water bill. The fee was based on water consumption as an indicator of trash quantity.
3. For each cubic meter of water used, NT$4 was charged for trash fee.
4. There was no direct connection between the amount of trash generated and the water bill.
5. Lacked incentive for citizens to reduce the trash they were generating.

5.(2) PBTCF, Continued

6. After July 2000, under PBTCF, citizens must use special TDEP bags for their trash.
7. The price of the bags is set at a rate of NT$0.45 per liter. And the recyclable materials recycle for free (no need to use the bags).
8. PBTCF system provides a direct correlation between the volume of trash generated and the fee collected.
9. PBTCF system has a direct economic incentive for citizens who generate less trash and pay less for trash fee.

5.(3)Taipei City certified trash bags

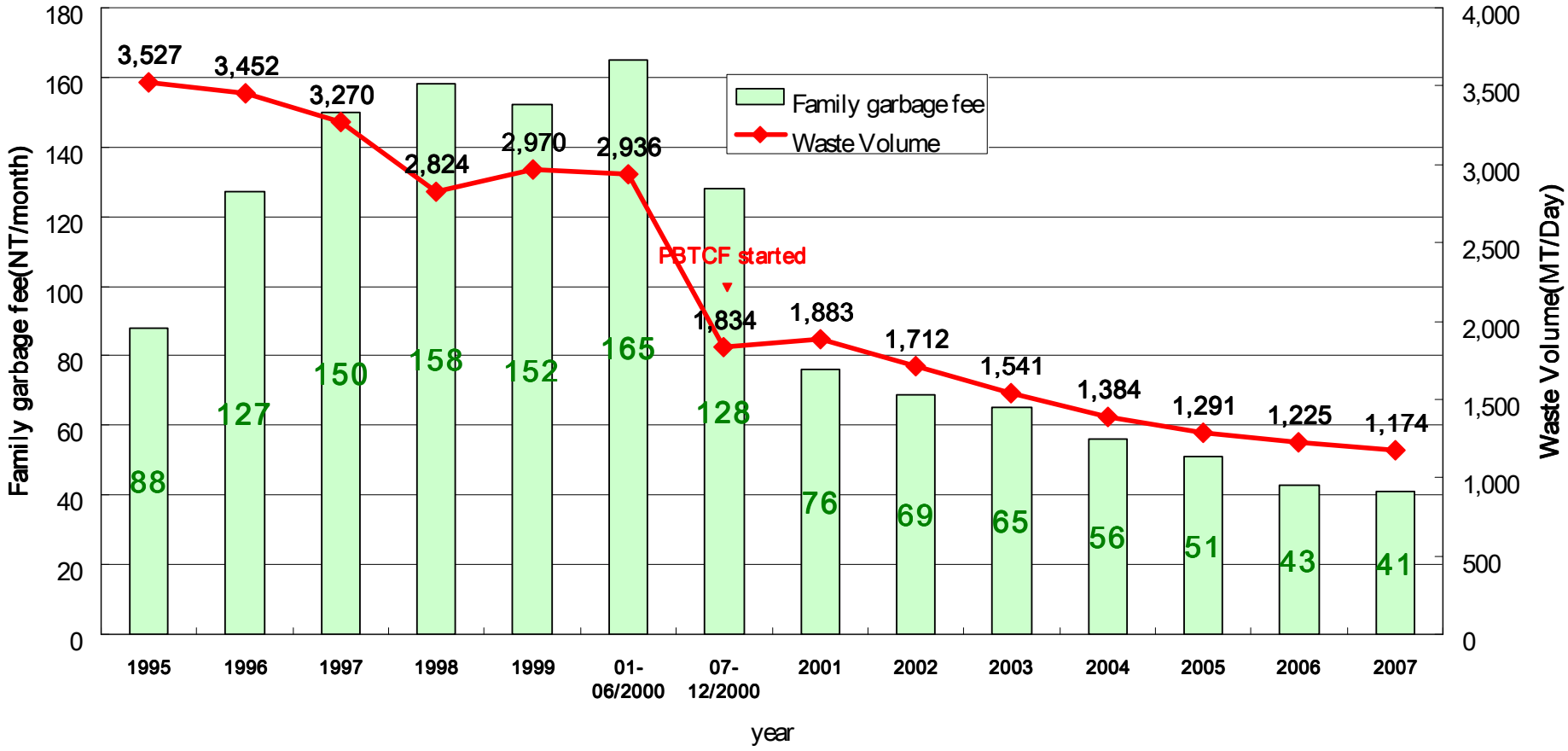
臺北市銷售專用垃圾袋最新規格及價格

商品名稱	每包個數	售價	備註
5公升袋	20個/包	45元	特小型袋
14公升袋	20個/包	126元	小型袋
25公升袋	20個/包	225元	中小型袋
33公升袋	20個/包	297元	中型袋
76公升袋	10個/包	342元	特大型袋
120公升袋	10個/包	540元	超特大型袋

93・元・製

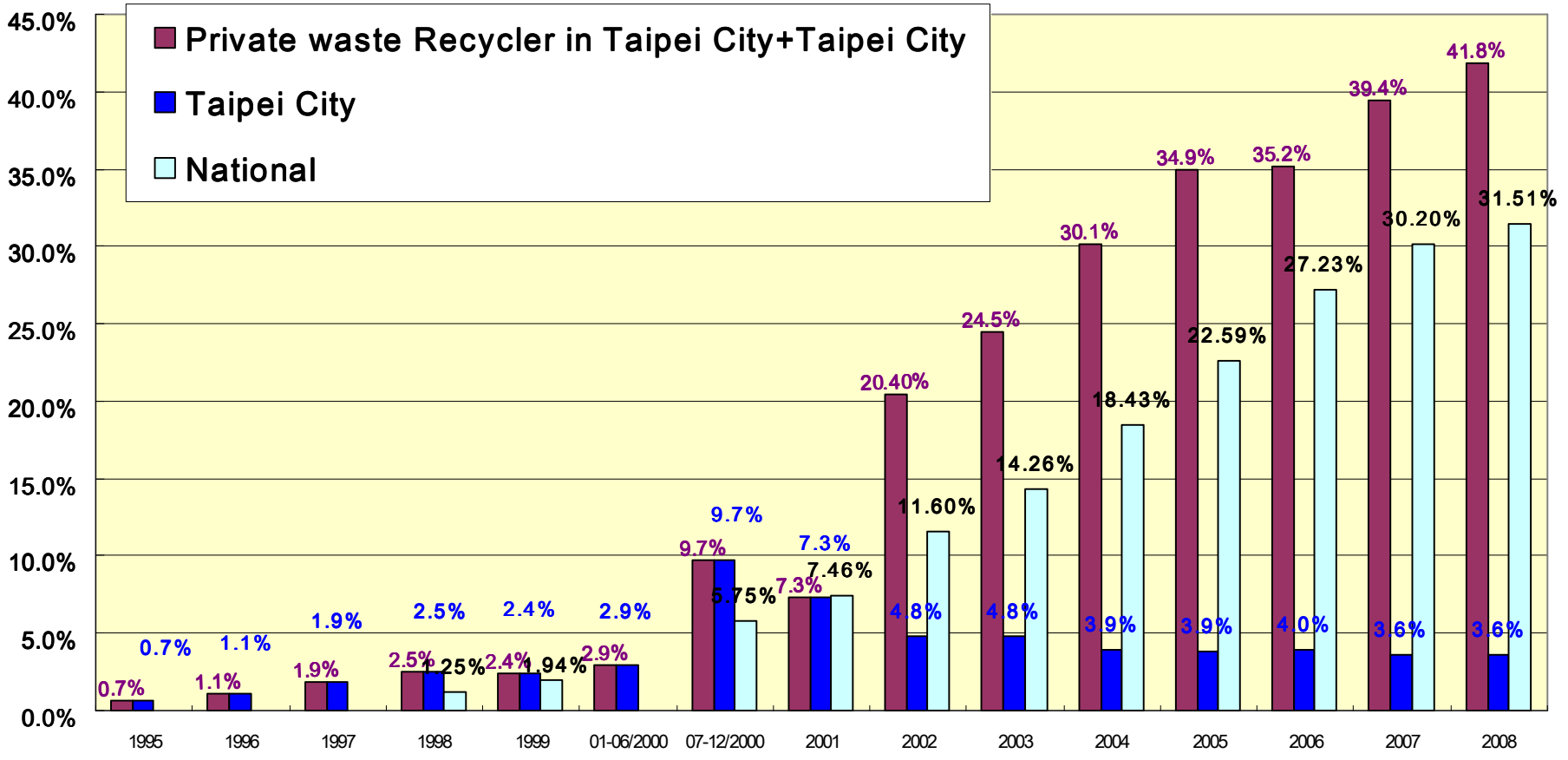
TAIPEI 臺北市政府環境保護局

5.(4) Garbage fee expense for each family in Taipei City from 1995 to 2007 (PBTCF Policy began from July 2000)



Remarks: 1.Trash Processing Fee collected through water bill: NT4per cubic meter. 2.PBTCF: NT$0.45 per liter the designed volume of trash bag.

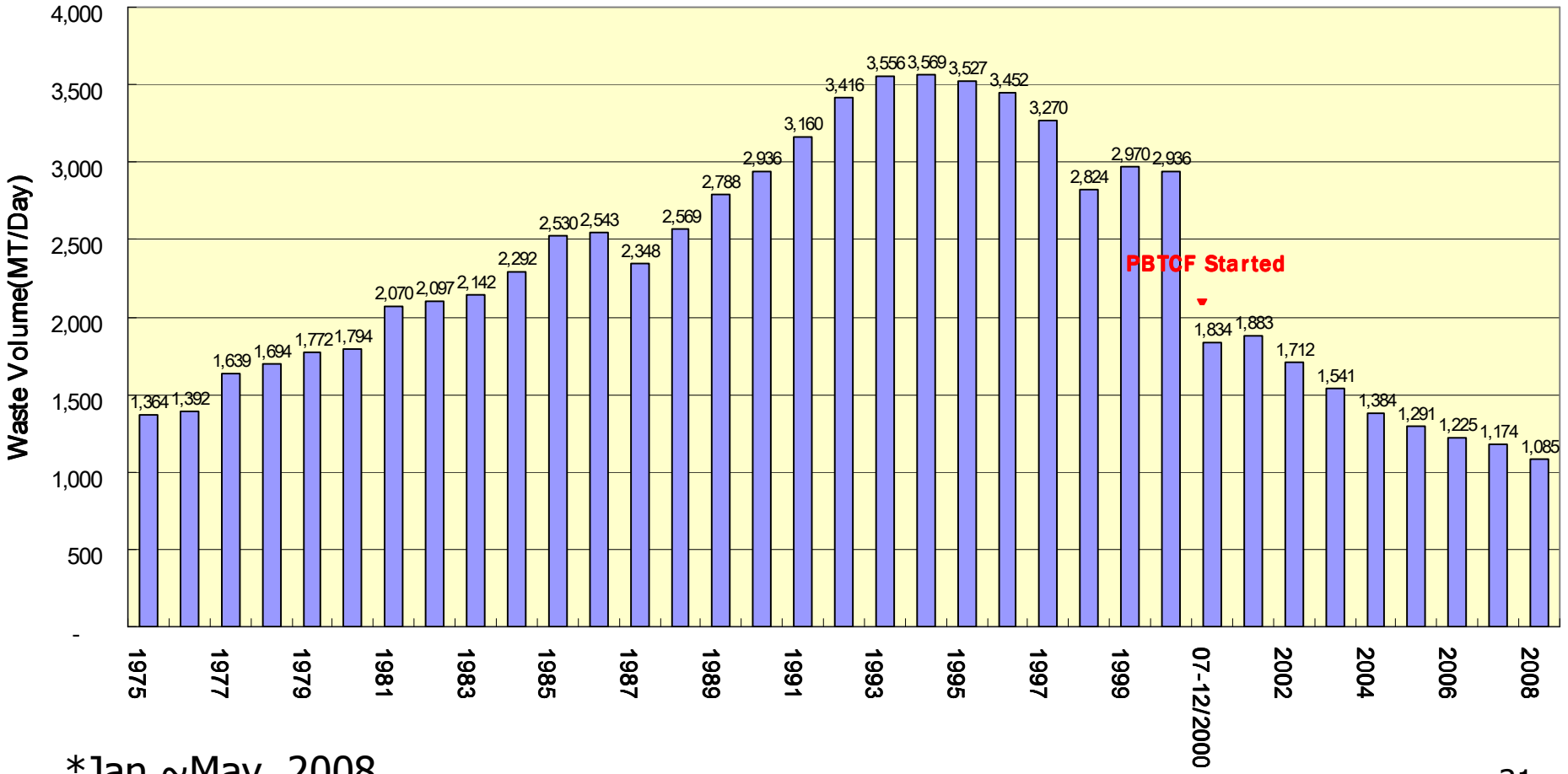
5.(5) The resources recycling rate in Taipei City and the whole country from 1995 to 2008.



*Jan.~Apr. 2008

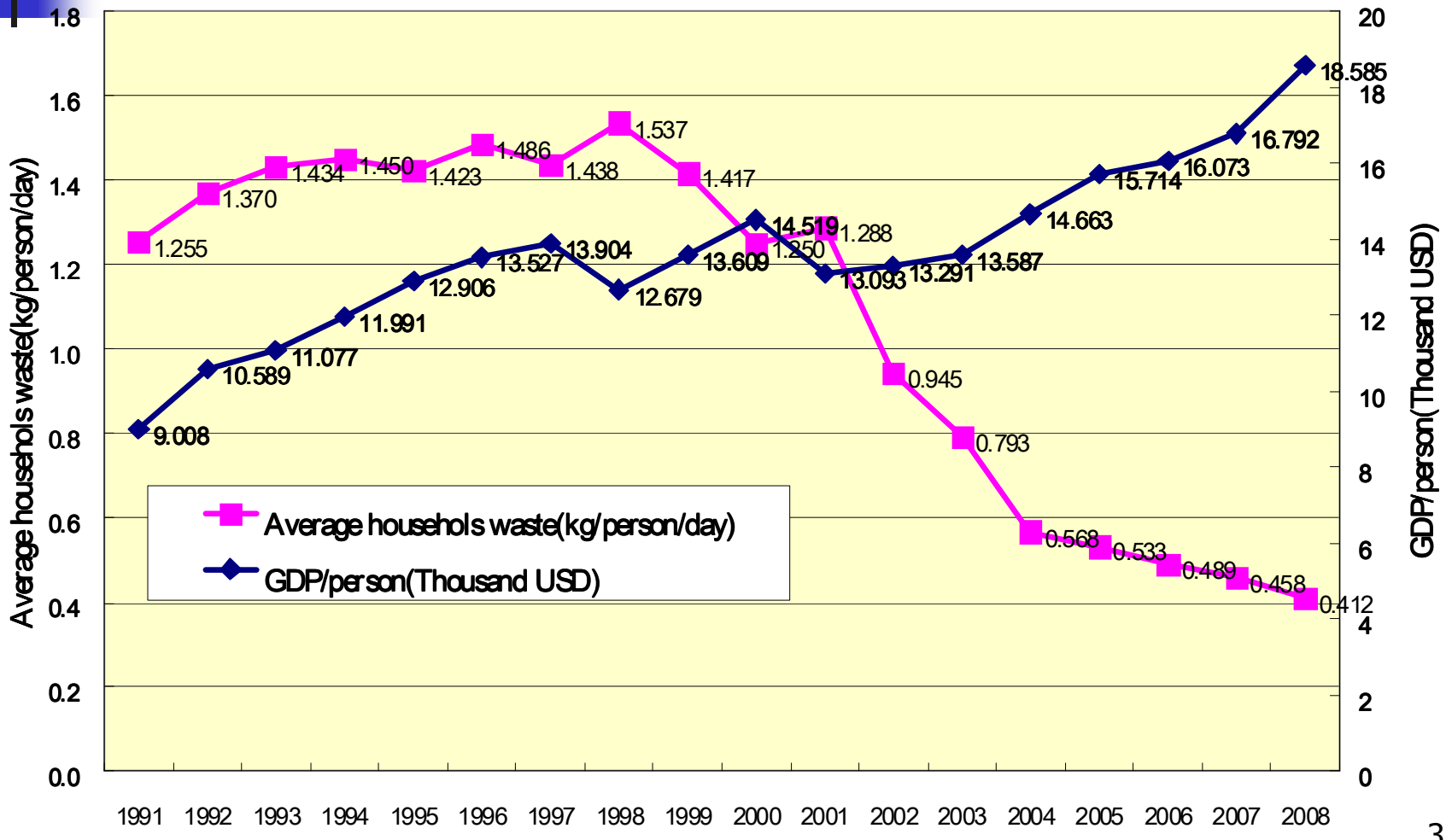
5.(6) Household Waste volume in Taipei City From 1975 to 2008.

(PBTCF Policy began from July 2000)



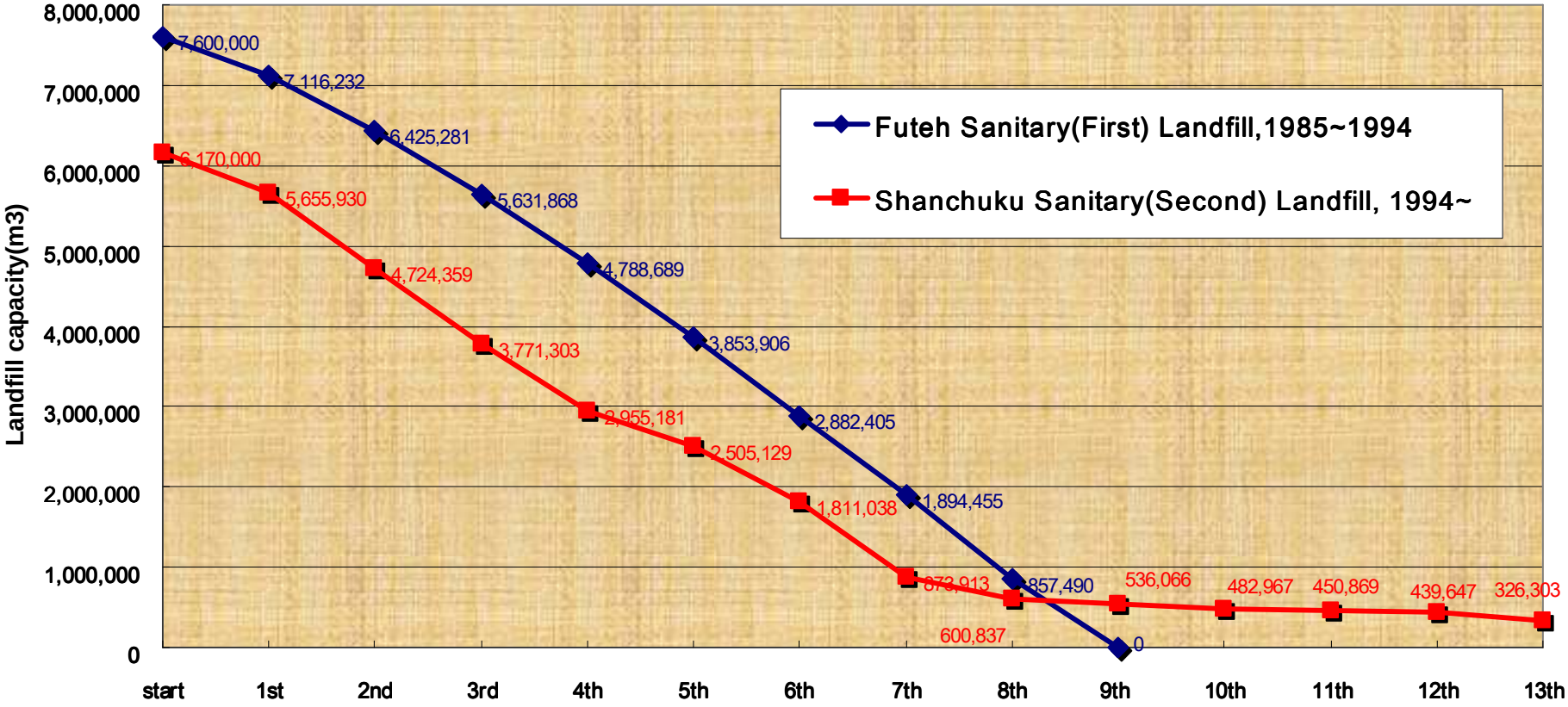
*Jan.~May. 2008

5.(7)The Comparison of Waste quantity in Taipei City and the Gross Domestic Product in Taiwan, 1991~2008



* Jan.~May, 2008

5.(8) Sanitary Landfill Capacity Depletion Rate in Taipei City



Regional Institute of Environmental Technology (RIET) honored Taipei City Government as the winner for the Asia Waste Management Excellence Award 2001

5.(9) Problems from the PBTCF system

- Counterfeit problems
- Manpower and Budget
- Litter problem
- Increase plastic use

5.(10) Anti-counterfeit seal

- The anti-counterfeit seal is printed by the same company which prints paper currency for the Taiwan Central Bank.
- Fines between NT$30,000 and NT$100,000 for each violation, and can lead to criminal prosecution.
- Reporting counterfeiters can receive up to 20% of the resulting fine collected.

5.(11) Counterfeit PBTCF Bags Inspection Statistics, 2000~2008

Year	Counterfeit Factory		Counterfeit Mold		Counterfeit Bag sale		Sent for Criminal prosecution	Guilty	Counterfeit Bag use
	case	person	case	person	case	person	person	person	case
2000(1)	1	2	1	1	8	9	12	0	0
2001	2	2	0	0	25	27	29	0	1,918
2002	0	1	0	0	2	2	3	24	2,275
2003	1	7	0	0	5	5	12	11	1,582
2004	0	0	0	0	0	0	0	1	1,270
2005	0	0	0	0	0	0	1	0	775
2006	1	1	0	0	1	4	0	0	540
2007	0	0	0	0	0	0	7	0	327
2008(2)	0	0	0	0	0	0	0	0	41
SUM	5	13	1	1	41	47	64	36	8,728

(1)Aug.~Dec. (2)Jan.~May.

5.(12)Comparision Between Household volume, Manpower and Cost for Waste clean up and Recycling before and after PBTCF

Year	Household waste volume (ton/D)	Manpower (person)	Direct cost for manpower (Million NT$)
1999	2970	1608	1,118
2000	2931	1608	1,174
	1834	*	
2001	1883	1608	1,230
2002	1712	1675	1,233
2003	1545	1675	1,203
2004	1338	1675	1,266
2005	1291	1675	1,295
2006	1225	1675	1,287
2007	1174	1679	1,216

***During July, 2000, in average there were 4,500 daily person-Trips made by police, government employees, and others to assist with warning and inspection for counterfeiters.**

5.(13) Litter problem
Street count of the Illegal Discarded garbage bags from Jan.1~Apr.30, 2008

- Illegal Discarded places: 182
- Illegal Discarded GARBAGE BAGS: 882/day
- Punishment: 4,734
- PBTCF Loss:
  882 x121daysx2.25NTD=240,124.5NTD
- Punishment Fee:
  4,734 x 1,200NTD=5,680,800NTD

5.(14) Increase plastic use

6.Kitchen Waste Recycling

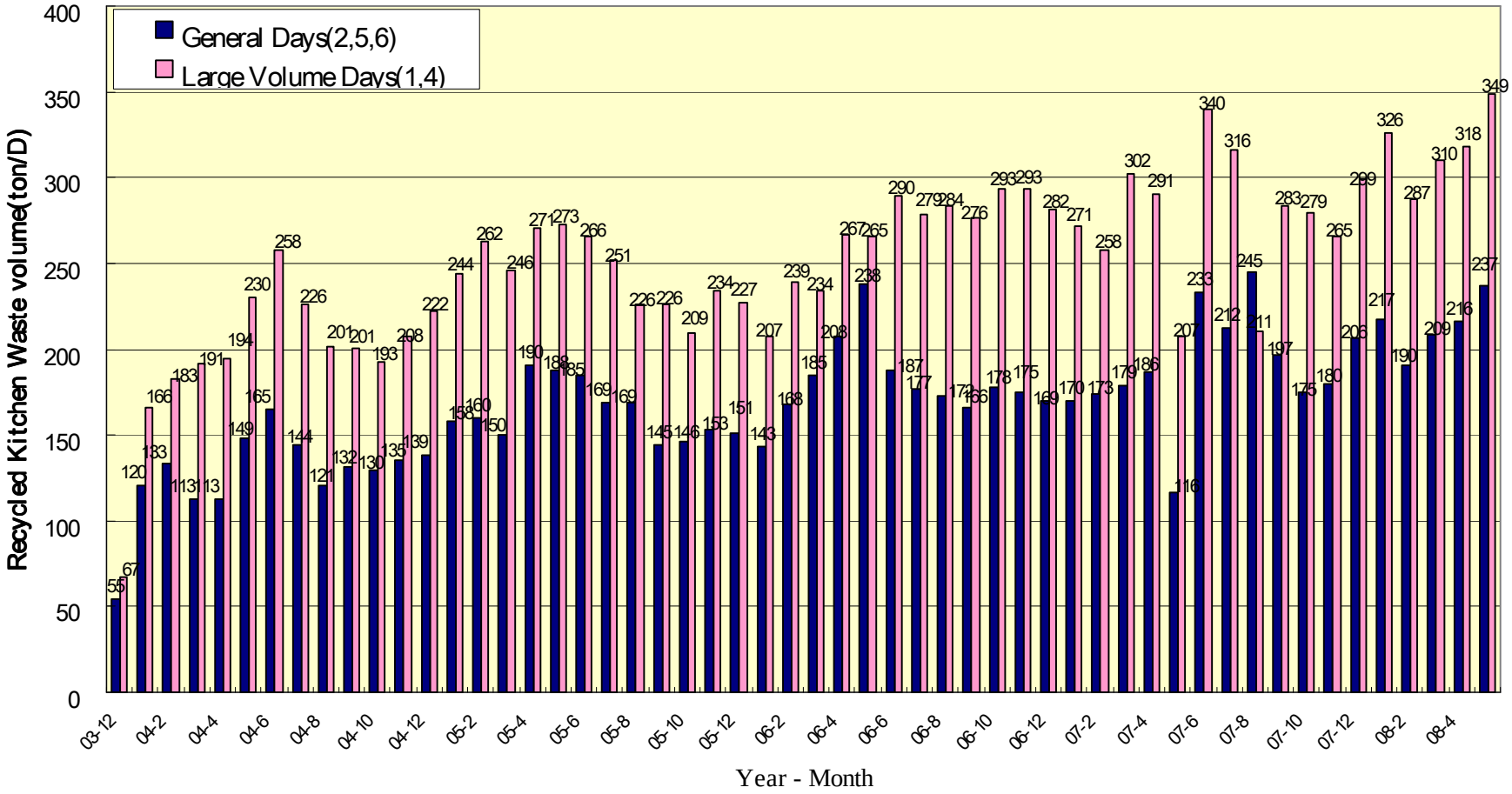
(1) Some basic information on kitchen waste in Taipei City

- 30% in household waste.
- May be used for animal feed, compost and methane formation.
- Remove the odor and chlorine from trash.

6.(2) Poster to promote separate collection of kitchen waste

6.(3) Kitchen waste collection truck in Taipei City. Kitchen waste and garbage can be collected simultaneously

6.(4) Kitchen Waste Recycling in Taipei City, Dec.03~Apr.08



6.(5) Inside of composting company in Central Taiwan (Formosa Plastic Company)

6.(6) The Composting plant in Shanchuku

Kitchen waste entrance

Unloading Kitchen waste

Turning kitchen waste by grab

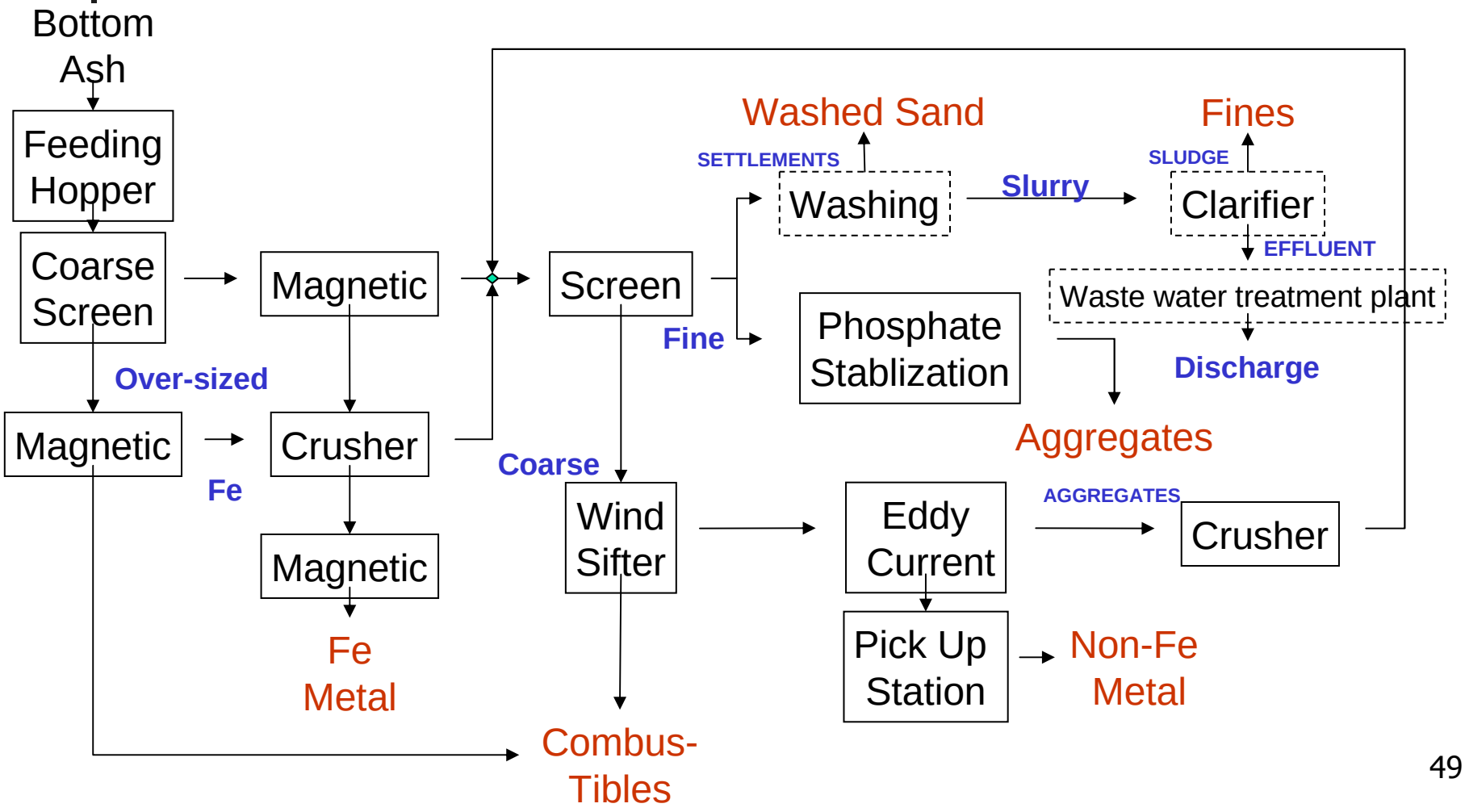
Turning kitchen waste by grab

7.Bottom Ash Reuse

(1) Some basic information on bottom ash in Taipei City

- Composition: sand, ceramics, glass, metals, organics, heavy metals (Pb, Cd, Hg, As, Cr…).
- General speaking, Bottom Ash is non-hazardous waste.
- 12%~16% of Bottom Ash remains after Incineration.
- Before 2004, after meeting the requirements of TCLP (Toxicity Characteristic Leaching Procedure) inspection, Bottom ash was landfilled.

7.(2) From 2004, the reprocessed bottom ash was reused. The process flow of Bottom Ash sorting plant(59MT/H) is as follows:



7.(3) A trial of bottom ash reuse in road pavement in Taipei City

8.Zero Landfill policy for 2010

Because of fast depletion of valuable sanitary landfills and difficulty in construction of No.3 landfill site, the idea of zero landfill came out in 2002.

Therefore, a series of waste reduction measures followed after PBTCF policy. Now, three items need to be solved before achieving the final goal of zero landfill.

(1) Fly Ash from Incinerators

(2) Bulky Wastes

(3) Disaster Wastes

8.(1) Fly Ash Reuse

a. Fly Ash

- Come from tiny particles in furnaces and air pollution prevention equipment.
- About 40 tons per day.
- Fly Ash is hazardous waste.
- 3% of total solid wastes becomes fly ash after incineration.
- After solidification or stabilization, fly ash is buried in landfills.

8.(1) b. Heavy Metals and PCDD/PCDFs contain in three Incinerator Fly Ash,2004

Incinerator / Pollutants	First Sampling			Second Sampling		
	Beitou	NeiHu	Mucha	Beitou	NeiHu	Mucha
As(mg/kg)	0.8	0.3	0.8	0.5	0.5	0.2
Hg(mg/kg)	3.0	2.1	0.1	3.2	2.1	0.1
Cr(mg/kg)	206	135	265	250	37	273
Pb(mg/kg)	2686	2948	10820	2217	3049	6890
Cd(mg/kg)	269	175	775	259	160	1034
Se(mg/kg)	0	0	1.33	0	0.58	0.34
PCDD/F (ng-TEQ/g)	0.299	0.268	1.915	0.399	0.749	0.795

8.(1) c. Leaching Test (TCLP) of the heavy metals from Solidified/Stablized Fly Ash in Taipei City(6/2003-6/2005)

PLANT NAME	TCLP (mg/l)						
	As	**Cr**	**Cd**	**Pb**	**Se**	**Hg**	**Cr^{+6}**
NEIHU	ND | 1.95	0.026 | 2.01	ND | 0.611	**3.13 ~ 9.27**	ND	ND | 0.018	ND
MUCHA	<0.2 | 0.233	0.055 | 0.801	<0.02 | 0.977	**<0.2 | 0.415**	ND	ND	ND | 0.512
PEITOU	ND | 0.227	ND | 0.478	ND | 0.516	**0.282 | 4.60**	ND	ND | 0.037	ND | 0.09
LIMITS	**5**	**5**	**1**	**5**	**1**	**0.2**	**2.5**

8.(1) d. Cl^- and SO_4^{-2} Contain in Fly ash

Incinerator / Pollutants	First Sampling			Second Sampling		
	Beitou	NeiHu	Mucha	Beitou	NeiHu	Mucha
Cl^-(mg/kg)	176,851	186,858	187,875	172,316	202,837	196,950
SO_4^{-2}(mg/kg)	57,431	64,459	80,648	64,268	51,255	73,907

8.(1) e. Temporary storage area in Shanchuku Landfill

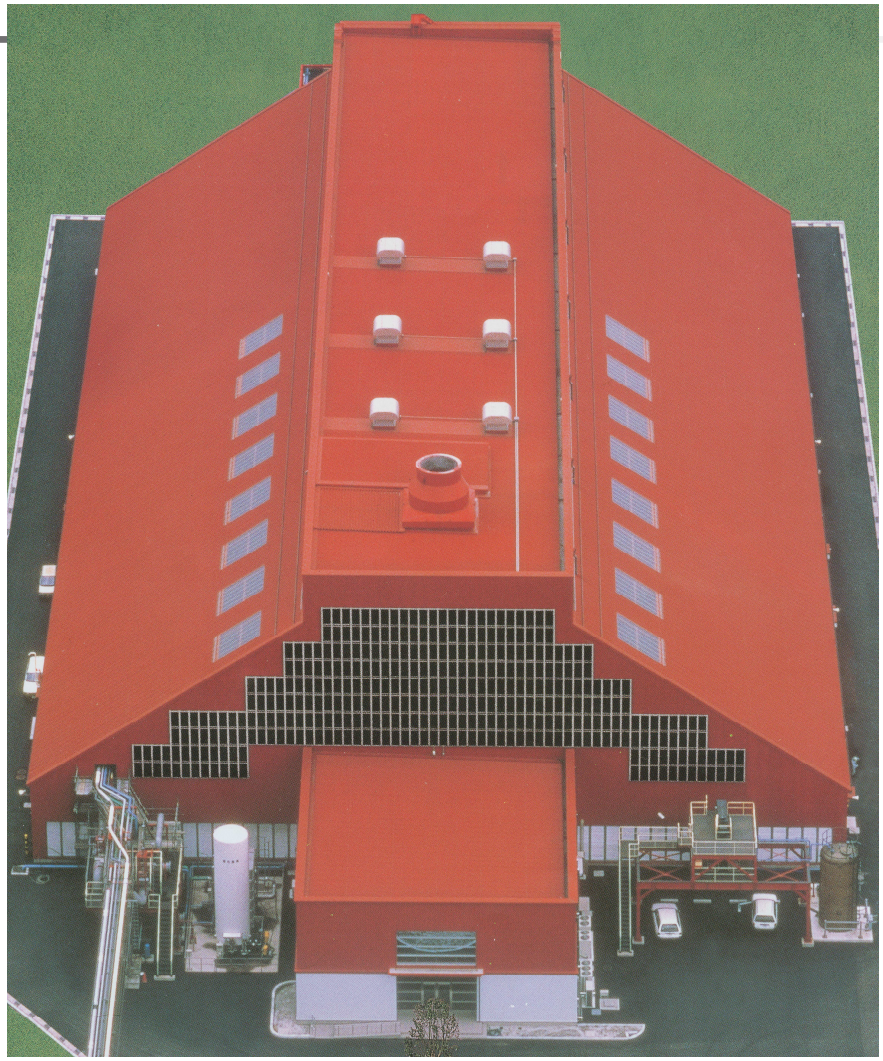
8.(1) f. Solidified fly ash berried in Shanchuku Sanitary Landfill

8.(1) g. Looking for Good Technologies

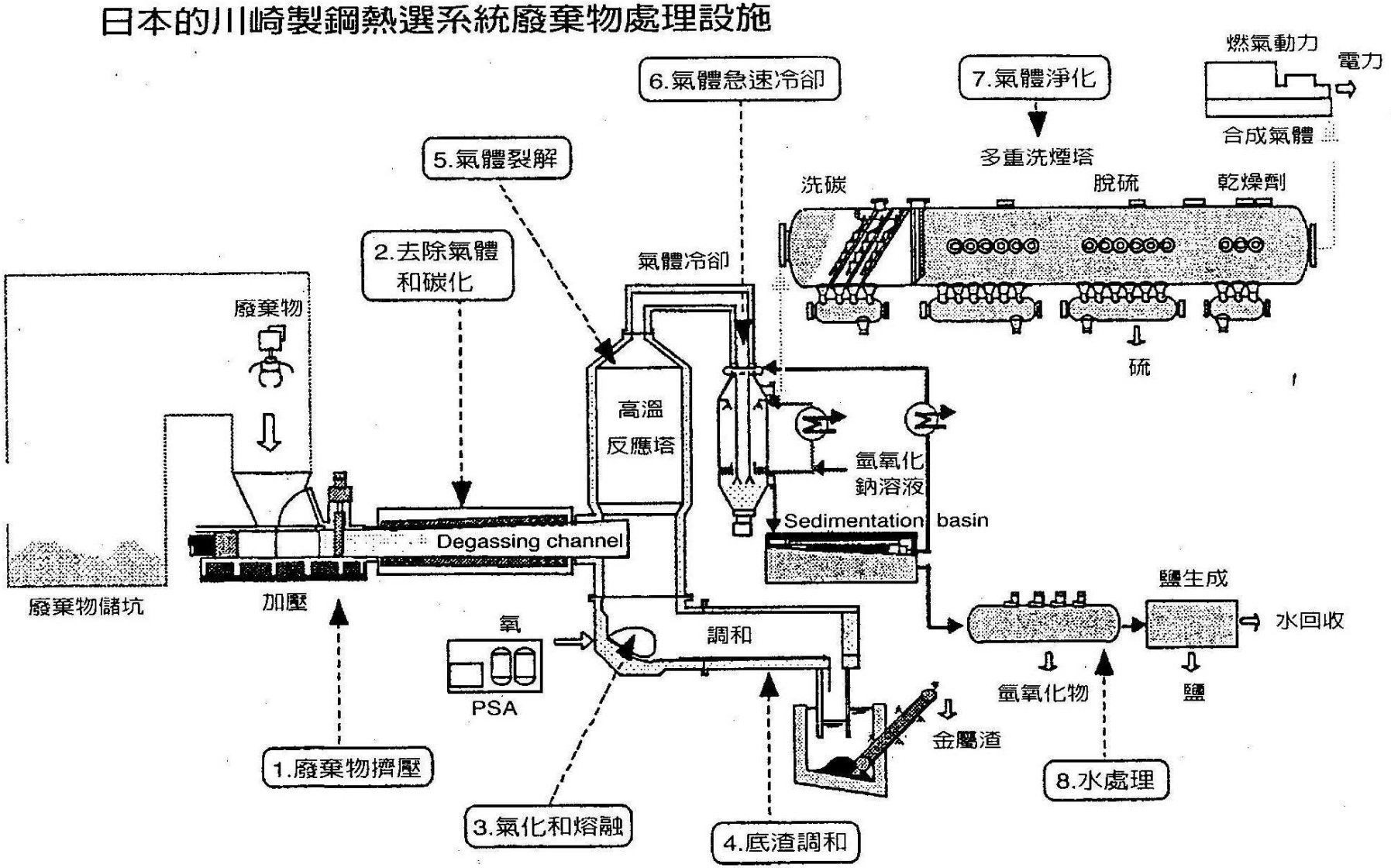
- Vitrification—High cost and high energy consumption.
- Wash out chlorine and Reuse in cement kiln.

1. Experimental testing is going on.
2. Low cost but technically still unreliable.

8.(1) h. Another Possibility—Thermoselect System



8.(1) i. The treatment process of Termoselect System



8.(2) Bulky Waste Reuse

a.

- Old desks, chairs, cabinets, etc.
- Repair and Reuse (From 2003)
- Un-repairable Giant Waste is crushed and Recycle metals, plastics, wood etc. (From 2006)

8.(2) b. Secondhand furniture display and auction place

8.(2) c. Display and public Auction

8.(3) Disaster Waste Reuse

a.

- Natural disaster: typhoons, earthquakes
- Waste: soaked furniture, fallen trees, alluvial soil, construction waste, etc.
- Waste Categorization: mattresses, tree trunks, large waste, inflammable waste, waste metals, and alluvial soil.
- Recycle useful materials such as metals, wood, sand, soil, etc.

8.(3) b. Sorting Makes Waste Recycle Easier

9.Future Outlook for waste Disposal in Taipei

- Ultimate Goal: Total Recycling and Zero Landfill
- Future Challenges:

◆Look for sound technologies for fly ash reuse

◆Monitor the reused materials, such as bottom ash, fly ash, sewage waste, etc.

◆Shred, sort, and recycle bulky waste and construction waste.

10.Conclusion

- Household Waste in Taipei City has been decreased 63% since 1999, after implementing the Per-bag Trash Collection Fee policy.
- The second sanitary landfill, Shanchuku Landfill, is still hoped to be used before 2020.
- Zero Landfill policy is the most pressing environmental issue in Taipei City.